The Effect of Education on Poverty

Ekansh Bharti

April 30, 2021

ECON 3161 Dr. Shatakshee Dhongde

Abstract

Everyone knows education as a keyway of gaining higher wages and escaping poverty. In this paper, I will be discussing the effect education has on poverty. I will specifically be looking at higher education, so the education variable is the percentage of people 25 years or older who have obtained a bachelor's degree or higher. The poverty variable is the poverty rate in each state. The data that I am using is cross sectional data of the United States, collecting values from each state. Other explanatory variables that were used were cost of living index, unemployment rate, labor force participation rate, urban percentage of the population, and GDP per capita. Most of the data was collected from 2018 to 2020, except the urban percent of population variable which was collected in 2010. I first created a simple regression model estimating the ceteris paribus effect education has on poverty. I then went ahead and created other multiple regression models and used F-stats and t-stats to find the significance of my explanatory variables. Through this study, I was able to prove that there is a strong negative relationship between education and poverty.

I. Introduction

Education has always been a keyway for people to receive higher wages in the economy. By going to college, you gain more knowledge, garner more skills, mature as a person and gain valuable experience. All of this is very valuable and to an employer it looks very impressive. You are separating yourself from the rest when you obtain a college degree, and this separation will often times yield better jobs and higher salaries. Many people that grow up in poverty-stricken areas, will make it their goal to get a bachelor's degree or graduate high school, so they can get these high paying jobs and break themselves and their family out of the cycle of poverty.

Poverty remains a problem in the United States. In 2019, nearly 34 million people were below the poverty line in the United States. The vast majority of people living below the poverty line in the United states are uneducated and are unemployed. Education, especially higher education, is often an outlet for people to escape poverty, as it is a way for these people to get a higher paying job that will get them out of poverty.

This paper will draw the relationship between education and poverty by using cross-sectional data to create both simple and multiple linear regression models. My hypothesis is that attaining higher education has a negative effect on the poverty rate, so as more people obtain higher education the lower the poverty rate will be. The economic rationale used to back this hypothesis is having a higher level of education will give you a better chance at acquiring a higher paying job, therefore increasing your income and an increase income will give you enough money to be above the poverty line. Other factors that I included in my sample data that could impact poverty are cost of living index, unemployment rate, labor force participation rate, urban percentage of the population, and GDP per capita. I will be using these variables as additional independent variables in my multiple regression model. The use of these extra independent variables will allow me to strengthen the ceteris paribus effect education has on the poverty rate.

II. Literature Review

To study the effect of education on poverty Citak and Duffy (2020) studied the two-way causality between the household head's education level and poverty in Turkey. To analyze the impact of education attainment on poverty, their study used cross-sectional data obtained from the Turkish Statistical Institute's Income and Living Conditions Survey in 2013. This study was different from other

studies that looked at the effect of education on poverty, as it considered the issue of a possible endogeneity problem. In this study they used an Instrument Variable(IV) probit model to analyze the casual effect of education on poverty. To identify the impact of education on poverty, they used two different education reforms one from the 1961 Turkish Educational Reform and the 1997 Compulsory Schooling reform. The study revealed that the educational reforms increased years of schooling for rural residents by 20 percent for the 1961 reform and 9 percent for the 1997 reform. These additional years of schooling increased the household head's income by 7.3 percent. They were able to conclude that these educational reforms that increased years of schooling, increases household's income. From their study, they also came up with policies to reduce poverty. One was to focus on women's education. Another policy was to improve the quality of education that promotes children's access to education. Another policy was to solve the problem of equal access to educational opportunities. The final policy was that the government should increase its role in education.

Shimeles and Verdier-Chouchane (2016) studied the role of education in a post-conflict South Sudan in reducing poverty. The data that was used to look at the causality between education and poverty was the 2009 NBHS questionnaire which surveyed 5,280 households across all ten states of South Sudan. The questionnaire measured information like the state poverty level, income distribution and labor markets. They first used a probit regression framework to determine the role of educational attainment on the risk of poverty. Then they used a method of estimation called Mincer's semi-logarithmic earnings function, which shows the estimated returns for each level of schooling. This earning function is a regression of earnings on different control variables. They then used concentration curves to assess progressivity of education subsidy. They were able to conclude that the returns to education are high and increasing with the level of education. They were ultimately able to prove that there is a negative relationship between education and poverty. When capturing the link between education and wages, they ran a simple regression and were able to see that a university graduate earns 188.6 percent more than a person with no education and someone with primary education earns 38.5 percent more than someone with no education. In conclusion, some policies they recommended to lower poverty in South Sudan was to focus on primary education. Another was to implement policies that reduce inequality and poverty in rural areas.

Khan, Alvi and Chrishti (2019) investigated the relationship between poverty and education. The data they used was secondary data from the federal Bureau of statistic. They performed a variety of different tests to explain the relationship between education and poverty elimination. Through a binary

logistic regression test they were able to show that poverty level decreases due to an increase in education level and were able to prove that education level has a significant negative relationship with poverty. Performing several other tests by dividing education into different levels, they were able to show that people who had middle and above standard level of education are richer than people who belong to primary or below level of education. They were able to prove that the higher level of education you have, the higher the income you will receive. Their results also showed that uneducated people are suffering the lowest level of poverty. Ultimately their findings showed that education is a critical factor in the elimination of poverty and that there is a strong negative relationship between the two variables.

Lupeja and Gubo (2017) analyzed the relationship between secondary education attainment and poverty reduction in Tanzania. This study uses the idea of human capital theory, where the skills and knowledge you acquire in secondary education will help with finding employment and reducing poverty. The data they used was a cross sectional survey which had a case study design used to select primary and secondary graduates in the Mvomero District in Tanzania. They used stratified sampling to obtain data from 400 participants and then used systematic sampling to select participants from each class level. The data was analyzed with the Mann Whitney U test to see if secondary education does play a significant role in poverty reduction in Tanzania. The data was analyzed to show how satisfied and capable primary and secondary education graduates were in business performance, in attracting and maintaining customers, and in managing a business. There was a far larger percentage of primary education graduates compared to secondary education graduates who were not satisfied with their education level in all three areas: business performance, attracting and maintain customers, and managing a business. From the results they were able to conclude that the skills and knowledge acquired in secondary education in Tanzania could be useful in reducing poverty because the skills and knowledge of secondary education would allow these people to get higher paying jobs and live more successful lives.

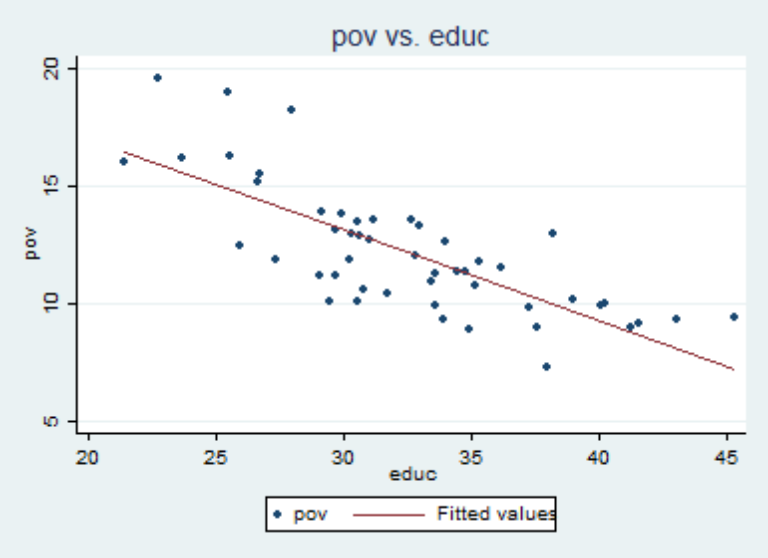
There is a lot of research out there studying the relationship between education and poverty, however my research is slightly different. In this paper I will be analyzing other explanatory variables along side education, that are not usually looked at it in other research papers. The other explanatory variables that I will be considering in my analysis are cost of living index, unemployment rate, labor force participation rate, urban percentage of the population, and GDP per capita. Analyzing these other variables will allow me to draw a more comprehensive relationship between education and poverty

because I will be able to control these other explanatory variables. When looking at other research papers on the relationship between education and poverty, they often take a look at developing areas and countries, that are in Europe or Asia. My research will be looking at education in the United states as whole and its effect on poverty. More specifically I will be looking at the effect of higher education on poverty, so how the completion of a bachelor's degree or higher effects the poverty rate. For these reasons, my research paper should provide a different look at how education affects poverty.

III. Data

Cross-sectional data was gathered to analyze the relationship between education and poverty. The dependent variable used is the poverty rate in each state of the United States. I choose to look at data from the entire nation. There are 50 poverty rate observations, one from each state and the data is sourced from the United States Census from 2019. The primary independent variable used is the percentage of people who have obtained a bachelor's degree or higher. This variable is a percentage from each state and it only includes people who are 25 years or older. There are 50 observations, one from each state and the data is sourced from the United States Census from 2019. The percentage values were calculated by taking the population of people 25 years and older who obtained a bachelor's degree or higher and dividing it by the population of people 25 years and older, and then multiplying it by 100 to get a percentage value. The reason why I choose to look at the entire nation and not just a specific county or state is because I wanted to capture the effect education had across the whole country and not just particular county or state. I also choose to represent my education variable as a percentage of people who have obtained a bachelor's degree or higher because I wanted to look more at how higher education effects the poverty rate. Below there is scatter plot of the dependent variable and primary independent variable, pov(poverty rate) and educ(percentage of people 25 years and oler who have obtained a bachelor's degree or higher).

Figure 1 – Scatterplot of pov vs. educ



In addition to education, which is the primary independent variable, I choose a few other independent variables for my multiple linear regression model to uncover the ceteris paribus effect education has on the poverty rate. The other independent variables are cost of living index, unemployment rate, labor force participation rate, urban percentage of the population, and GDP per capita. I choose these independent variables because these variables have a big influence on the poverty rate, so I want to take them into account in the multiple regression model to strengthen the ceteris paribus effect education has on the poverty rate. There are also other factors/variables that effect the poverty rate that I will not be able to include. The cost of living in each state is one of the independent variables. The data is sourced from the Missouri Economic Research and Information Center and there are 50 observations one from each state from 2020. Unlike the other values, which are percentages the cost-of-living value is an index value. The unemployment rate is another independent variable. The data is sourced from the U.S. Bureau of Labor Statistics and there are 50 observations one observation from each state from February 2019. The next independent variable I choose was labor force participation rate. The data is sourced from FRED and there are 50 observations one observation from each state from February 2019. Another independent variable I choose was the urban percentage of the population. The data is sourced from the Decennial Census, U.S. Census Bureau, and there 50 observations one from each state from 2010. The final independent variable I looked at was the GDP per capita. The data is sourced from the State Science & Technology Institute and there are 50 observations

one from each state from 2018. The GDP per capita is dollar value, so besides the GDP per capita which is a dollar value and the cost of living index which is an index value, the other variables are percentage values.

Table 1 – Variable Descriptions

	Description	Year	Units	Source
pov	Poverty rate	2019	Percentage	United States Census
educ	Percentage of people 25 years or older who have obtained a bachelor's degree or higher	2019	Percentage	United States Census
cos	Cost of living index	2020	Index	Missouri Economic Research and Information Center
unemploy	Unemployment rate	2019	Percentage	U.S. Bureau of Labor Statistics
lab	Labor force participation rate	2019	Percentage	FRED
urb	Urban Percentage of the Population	2010	Percentage	Decennial Census, U.S. Census Bureau
gdp	Gross Domestic Product per Capita	2018	Dollar Value	State Science & Technology Institute

The table below shows the descriptive statistics for each variable.

Table 2 – Variable Descriptive Statistics

Variable	Observations	Mean	Std. Dev.	Min.	Max.
pov	50	12.14	2.70	7.3	19.6
educ	50	32.54	5.34	21.37	45.34
cos	50	104.68	20.34	84.5	198.6
unemploy	50	3.71	0.83	2.4	6.5
lab	50	63.55	3.85	54.6	70.2
urb	50	73.59	14.57	38.7	95
gdp	50	52890	9950.70	34029	73531

Before moving into the regression models, the Classical Linear Model Assumptions were checked:

1. Model is linear in parameters – this assumption is satisfied because in my model the relationship between the dependent and independent variables are linear.
2. Data was obtained from random sampling – this assumption is also satisfied because the sources where I got data from, collected the data using random sampling.
3. No perfect collinearity– this assumption is also satisfied because I used STATA software to check for collinearity between the independent variables. Looking at the results from STATA, none of the independent variables are constant and there are no exact linear relationships among the independent variables. The results can be referenced at the end in the Appendix.
4. Zero Conditional Mean – this assumption is hard to assume because there are likely other factors that affect the poverty rate. Since I cannot completely guarantee that this assumption is satisfied, I will interpret the results and data with caution.
5. Homoskedasticity – this assumption is hard to assume because the value of the explanatory variables containing no information about the mean of unobserved factors is difficult to assume. Since I cannot completely guarantee that this assumption is satisfied, I will interpret the results and data with caution.

6. Normality of Error – this is assumption is hard to assume because assumptions 4 and 5 are not completely satisfied, and so I cannot verify if the error term *u* follows a normal distribution. Since I cannot completely guarantee that this assumption is satisfied, I will interpret the results and data with caution.

IV. Results

Simple Regression Model

Model 1

$$pov = B_0 + B_1(educ) + u$$

$$pov = 24.608 - 0.383(educ) + u$$

Source	SS	df	MS	Number of obs	=	50
				F(1, 48)	=	64.69
Model	204.812149	1	204.812149	Prob > F	=	0.0000
Residual	151.971051	48	3.16606356	R-squared	=	0.5741
				Adj R-squared	=	0.5652
Total	356.7832	49	7.2812898	Root MSE	=	1.7793

pov	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
educ	-.3830476	.047625	-8.04	0.000	-.4788041	-.2872912
_cons	24.60753	1.56991	15.67	0.000	21.45101	27.76404

In this simple regression model, poverty rate(pov) is the dependent variable and the percentage of people 25 years and older who have obtained a bachelor's degree or higher is the independent variable(educ). This model returned a -0.383 coefficient for the educ variable. The R-squared value is 0.5741, and what this means is that the percentage of people 25 years and older who have obtained a bachelor's degree or higher(educ) explains 57.41% of the variability in the poverty rate around its mean. Also, the t value for educ is -8.04 so it is statistically significant at the 1%, 5% and 10% level of significance. With a relatively high R-squared value and the fact that the educ coefficient is negative, it supports the hypothesis I made at the beginning of the paper that education and poverty have a negative relationship. As the percentage of people 25 years and older who have obtained a bachelor's degree or higher increases by 1%, the poverty decreases by 0.383%.

Multiple Regression Models

Model 2

$$pov = B_0 + B_1(educ) + B_2(cos) + B_3(unemploy) + B_4(lab) + B_5(urb) + B_6(gdp) + u$$

$$pov = 47.692 - 0.127(educ) - 0.039(cos) + 0.112(unemploy) - 0.451(lab) + 0.003(urb) + 0.00001(gdp) + u$$

Source	SS	df	MS	Number of obs	=	50
				F(6, 43)	=	33.26
Model	293.532803	6	48.9221339	Prob > F	=	0.0000
Residual	63.2503968	43	1.47093946	R-squared	=	0.8227
				Adj R-squared	=	0.7980
Total	356.7832	49	7.2812898	Root MSE	=	1.2128

pov	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
educ	-.126557	.0521203	-2.43	0.019	-.2316677	-.0214463
cos	-.0390129	.0112934	-3.45	0.001	-.0617882	-.0162376
unemploy	.1123989	.2765974	0.41	0.686	-.4454129	.6702107
lab	-.4509036	.0766009	-5.89	0.000	-.605384	-.2964231
urb	.0030458	.0146115	0.21	0.836	-.0264212	.0325127
gdp	.0000126	.0000281	0.45	0.655	-.000044	.0000693
_cons	47.69266	4.842984	9.85	0.000	37.92585	57.45946

This multiple linear regression model considers other explanatory variables. In this model the dependent variable is the poverty rate, but the independent variables are educ(the percentage of people 25 years and older who have obtained a bachelor's degree or higher), cos(cost of living index), unemploy(unemployment rate), lab(labor force participation rate), urb(urban percentage of the population), and gdp(GDP per capita). Looking at the coefficients for each variable, educ's coefficient is -0.127 so when educ increases by 1%, poverty rate decreases by 0.127 percent. Cos's coefficient is -0.039, so when the cost-of-living index increase by 1 the poverty rate decreases by 0.039 percent. Unemploy's coefficient is 0.112, so when the unemployment rate increases by 1% the poverty rate increases by 0.112 percent. Lab's coefficient is -0.451, so when exp increases by 1% the poverty rate decreases by 0.451 percent. Urb's coefficient is 0.003, so when the lab increases by 1% the poverty rate increases by 0.003 percent. Gdp's coefficient is 0.00001, so when the gdp increases by 1% the poverty rate increases by 0.00001 percent. The R-squared value is 0.822, and what this means is that all the

independent variables used in this model explain 82.27% of the variability in the poverty rate around its mean. Looking at all this data my hypothesis still holds because when educ increases it causes the poverty rate to decrease, so education has a negative relationship with poverty. Looking also at the magnitude of the coefficients, we see that educ, unemploy and lab have the biggest affect on the poverty rate. We also see that gdp has very little to no effect on the poverty rate as its coefficient is very small. Educ has a t-statistic of -2.43 and a p value of 0.019, so it is statistically significant at the 5% level and 10% level. Cos has a t-statistic of -3.45 and a p value of 0.001, so it is statistically significant at the 1% level, 5% level, and 10% level. Unemploy has a t-statistic of 0.41 and a p value of 0.686, so it is not statistically significant at any level therefore it is statistically insignificant. Lab has a t-statistic of -5.89 and a p value of 0.000, so it is statistically significant at the 1% level, 5% level and 10% level. Urb has a t-statistic of 0.21 and a p value of 0.836, so it is not statistically significant at any level therefore it is statistically insignificant. Gdp has a t-statistic of 0.45 and a p value of 0.655, so it is not statistically significant at any level therefore it is statistically insignificant.

Model 3

$$pov = B_0 + B_1(educ) + B_2(cos) + B_3 lab + u$$

$$pov = 48.554 - 0.117(educ) - 0.036(cos) - 0.453(lab) + u$$

Source	SS	df	MS	Number of obs	=	50
				F(3, 46)	=	69.54
Model	292.326518	3	97.4421725	Prob > F	=	0.0000
Residual	64.4566824	46	1.40123223	R-squared	=	0.8193
				Adj R-squared	=	0.8076
Total	356.7832	49	7.2812898	Root MSE	=	1.1837

pov	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
educ	-.1172395	.0477932	-2.45	0.018	-.2134422	-.0210367
cos	-.0363716	.0099926	-3.64	0.001	-.0564856	-.0162575
lab	-.4529687	.058105	-7.80	0.000	-.5699279	-.3360094
_cons	48.55406	3.205924	15.15	0.000	42.10087	55.00724

Using the results from the Model 2, the variables unemploy, urb and gdp were dropped from this model because from the results we learned that those variables were statistically insignificant at the 1% level, 5% level and 10% level. So, this multiple linear regression model considers only educ, cos, and lab as the independent variables. In this model the dependent variable remains the same, it is the poverty rate.

Looking at the coefficients for each variable, educ's coefficient is -0.117 so when educ increases by 1% poverty rate decreases by 0.117 percent. Cos's coefficient is -0.036, so when the cost-of-living index increase by 1, the poverty rate decreases by 0.036 percent. Lab's coefficient is -0.453, so when the lab increases by 1% the poverty rate decreases by 0.453 percent. The R-squared value is 0.819, and what this means is that all the independent variables used in this model explain 81.93% of the variability in the poverty rate around its mean. Looking at all this data my hypothesis still holds because when educ increases it causes the poverty rate to decrease, so education has a negative relationship with poverty. Educ has a t-statistic of -2.45 and a p value of 0.018, so it is statistically significant at the 5% level and 10% level. Cos has a t-statistic of -3.64 and a p value of 0.001, so it is statistically significant at the 1% level, 5% level, and 10% level. Lab has a t-statistic of -7.80 and a p value of 0.000, so it is statistically significant at the 1% level, 5% level and 10% level.

Table 3 – Regression Models Summary

Dependent Variable: *pov*			
Independent Variables	**Model 1**	**Model 2**	**Model3**
educ	-0.383*** (0.048)	-0.127** (0.052)	-0.117** (0.048)
cos		-0.039*** (0.011)	-0.036*** (0.010)
unemploy		0.112 (0.277)	
lab		-0.451*** (0.077)	-0.453*** (0.058)
urb		0.003 (0.015)	
gdp		0.00001 (0.00003)	
Intercept	24.608 (1.57)	47.693 (4.843)	48.554 (3.206)
Number of Observations	50	50	50
R-squared	0.574	0.823	0.819

Adjusted R-squared	0.565	0.798	0.808

Significant at *10%, **5%, ***1%

V. Extension

After creating Model 2 and Model 3, we were able to identify variables that were individually insignificant using the t-statistics values. Unemploy, urb and gdp were identifited as being individually statistically insignificant and that is why they were removed from Model 3. Now using the F-test I am going to see if these 3 variables are jointly significant. For the F-test, the unrestricted model will be Model 2, with all the variables, and our restricted model will be Model 3 where unemploy, urb and gdp have been removed.

Unrestricted Model: $pov = 47.692 - 0.127(educ) - 0.039(cos) + 0.112(unemploy) - 0.451(lab) + 0.003(urb) + 0.00001(gdp) + u$

Restricted Model: $pov = 48.554 - 0.117(educ) - 0.036(cos) - 0.453(lab) + u$

Testing the joint significance of unemploy, urb and gdp, we have the following hypothesis:

$$H_0: \quad B_3 = 0, B_5 = 0, B_6 = 0$$

$$H_1: \quad H_0 \text{ is false}$$

Once the hypothesis is set up, I went ahead and solved for the F-statistiscs

$$F = \frac{({R_{ur}}^2 - {R_r}^2)/q}{(1 - {R_{ur}}^2)/(n - k - 1)} = \frac{(0.8227 - 0.8193)/3}{(1 - 0.8227)/(50 - 6 - 1)} = 0.275$$

Using tables with the critical values of the F distribution table we know that –

$F_{3,43} = 4.31$ at 1% significance level

$F_{3,43} = 2.84$ at 5% significance level

$F_{3,43} = 2.23$ at 10% significance level

Since 0.275 < 2.23, 0.275 < 2.84, and 0.275 < 4.31, we can conclude that unemploy, urb and gdp are not jointly significant at the 1% level of significance, 5% level of significance and 10% level of significance.

So, in conclusion -

- At 1% level of significance, we fail to reject the null hypothesis and so unemploy, urb, and gdp are jointly insignificant.
- At 5% level of significance, we fail to reject the null hypothesis and so unemploy, urb, and gdp are jointly insignificant.
- At 10% level of significance, we fail to reject the null hypothesis and so unemploy, urb, and gdp are jointly insignificant.

VI. Conclusions

After creating the simple linear regression model, creating multiple linear regression models, and testing the significance of the independent variables, I was able to conclude that my original hypothesis still holds. In each model I saw a strong negative relationship between education and poverty. After checking for significance on each independent variable educ was significant at the 5% level and 10% level in model 2 and model 3. Specifically looking at the model 3, where I removed the variables that were statistically insignificant, for every one percent increase in the population of people 25 years and older who obtained a bachelor's degree or higher there is a 0.117 percent decrease in the poverty rate.

After creating model 2 and checking the significance of each independent variable, I was able to remove unemployment rate, GDP per capita and urban percentage of the population because those variables were statistically insignificant. The variables that remained and were still statistically significant were percentage of people 25 years or older who have obtained a bachelor's degree or higher(educ), labor force participation rate(lab), and cost of living index(cos). So, labor force participation rate and cost of living index were statistically significant and their effect on poverty was very interesting. A 1% increase in the labor force participation rate, causes 0.453 percent decrease in the poverty, which was what I assumed from the beginning because as more and more people enter the work force, I assumed it would cause the poverty rate to decrease. The effect cost of living index has on poverty rate was interesting because in model 2 and model 3, there was a negative relationship, so as the cost of living index increases the poverty rate decreases but when I first started the project I assumed it would be the other way around. I thought that as the cost of living decreases, the poverty rate would decrease because it would be cheaper to live and so more people would be able to get out of poverty.

Some of the limitations faced in my paper was that my data only covered the United States. Only focusing on the United States did not allow me to see how education effects poverty in other areas. Another limitation was that my education variable only looked at higher education, so I was not able to see how a high school education affects poverty.

Overall, from the results of this paper, further research can be conducted to expand on this topic. To expand on this topic, more secondary independent variables can be used in the regression models. Also expanding the data to focus on international data, since mine only focused on the United States. Another way to expand on this research would be to adjust the education variable. I primarily focused on higher education, but you can adjust it to see how high school education effects poverty.

References

Khan, M. Y., Alvi, A. K., & Chishti, M. F. (2019). An Investigation on the Linkages between Poverty and Education: A Statistical Review. *Gomal University Journal of Research*, *35*(1), 44–53.

Lupeja, T. L., & Gubo, Q. (2017). Secondary Education Attainment and Its Role in Poverty Reduction: Views of Graduates Working in Informal Sector in Rural Tanzania. *Journal of Education and Practice*, *8*(11), 140–149.

ÇITAK, F., & DUFFY, P. A. (2020). The causal effect of education on poverty: evidence from Turkey. *Eastern Journal of European Studies*, *11*(2), 251–265.

Shimeles, A., & Verdier, C. A. (2016). The Key Role of Education in Reducing Poverty in South Sudan. *African Development Review*, *28*, 162–176. https://doi.org/10.1111/1467-8268.12199

Cost of Living Data Series. Search Results | Missouri Economic Research and Information Center. (n.d.). https://meric.mo.gov/mogov-search/results?search=+cost+of+living+2019.

Federal Reserve Bank of St. Louis. (n.d.). *Release Tables: Labor Force Participation Rate*. FRED. https://fred.stlouisfed.org/release/tables?rid=446&eid=784070.

POVERTY STATUS IN THE PAST 12 MONTHS. Explore Census Data. (n.d.). https://data.census.gov/cedsci/table?q=United+States&t=Poverty&g=0100000US.04000.001&tid=ACSST1Y2019.S1701&hidePreview=true.

U.S. Bureau of Labor Statistics. (2019, April 2). *Unemployment rates declined over the month in 4 states in February 2019*. U.S. Bureau of Labor Statistics. https://www.bls.gov/opub/ted/2019/unemployment-rates-declined-over-the-month-in-4-states-in-february-2019.htm.

Urban Percentage of the Population for States, Historical. Urban Percentage of the Population for States, Historical | Iowa Community Indicators Program. (n.d.). https://www.icip.iastate.edu/tables/population/urban-pct-states.

Useful Stats: Per Capita Gross State Product, 1998-2018. SSTI. (n.d.). https://ssti.org/blog/useful-stats-capita-gross-state-product-1998-2018.

Appendix

Appendix A. Correlation coefficients between all variables used to satisfy Gauss-Markov Assumption 3

	pov	educ	cos	unemploy	lab	urb	gdp
pov	1.0000						
educ	-0.7577	1.0000					
cos	-0.4385	0.4849	1.0000				
unemploy	0.4633	-0.3105	-0.0245	1.0000			
lab	-0.8095	0.6075	0.0801	-0.5335	1.0000		
urb	-0.3075	0.4462	0.4015	0.1337	0.1885	1.0000	
gdp	-0.5997	0.6380	0.4907	-0.0404	0.5418	0.4836	1.0000

Appendix B. STATA Outputs

Model 1

Source	SS	df	MS	Number of obs	=	50
				F(1, 48)	=	64.69
Model	204.812149	1	204.812149	Prob > F	=	0.0000
Residual	151.971051	48	3.16606356	R-squared	=	0.5741
				Adj R-squared	=	0.5652
Total	356.7832	49	7.2812898	Root MSE	=	1.7793

pov	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
educ	-.3830476	.047625	-8.04	0.000	-.4788041	-.2872912
_cons	24.60753	1.56991	15.67	0.000	21.45101	27.76404

Model 2

Source	SS	df	MS	Number of obs	=	50
				F(6, 43)	=	33.26
Model	293.532803	6	48.9221339	Prob > F	=	0.0000
Residual	63.2503968	43	1.47093946	R-squared	=	0.8227
				Adj R-squared	=	0.7980
Total	356.7832	49	7.2812898	Root MSE	=	1.2128

pov	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
educ	-.126557	.0521203	-2.43	0.019	-.2316677	-.0214463
cos	-.0390129	.0112934	-3.45	0.001	-.0617882	-.0162376
unemploy	.1123989	.2765974	0.41	0.686	-.4454129	.6702107
lab	-.4509036	.0766009	-5.89	0.000	-.605384	-.2964231
urb	.0030458	.0146115	0.21	0.836	-.0264212	.0325127
gdp	.0000126	.0000281	0.45	0.655	-.000044	.0000693
_cons	47.69266	4.842984	9.85	0.000	37.92585	57.45946

Model 3

Source	SS	df	MS	Number of obs	=	50
				F(3, 46)	=	69.54
Model	292.326518	3	97.4421725	Prob > F	=	0.0000
Residual	64.4566824	46	1.40123223	R-squared	=	0.8193
				Adj R-squared	=	0.8076
Total	356.7832	49	7.2812898	Root MSE	=	1.1837

pov	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
educ	-.1172395	.0477932	-2.45	0.018	-.2134422	-.0210367
cos	-.0363716	.0099926	-3.64	0.001	-.0564856	-.0162575
lab	-.4529687	.058105	-7.80	0.000	-.5699279	-.3360094
_cons	48.55406	3.205924	15.15	0.000	42.10087	55.00724